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(54) Abstract Title
A power management method for a personal digital assistant (PDA)

(57) A radio telephone is connectable to a personal digital assistant. When the telephone is switched on 200, the battery voltage Vc of the PDA is detected and compared 204 against a first reference level Vo. If Vc is less than Vo, an audible or visual alarm is produced 218 and power is withheld from the telephone. If Vc is greater than Vo, the battery voltage drop Ve which is expected to occur when the telephone is powered is read from memory 206 and subtracted 208 from Vc. If the result is greater than a second reference voltage Vi below which the PDA is inoperable, power is supplied 210 from the PDA to the telephone. Otherwise an alarm 212 is produced until the telephone is turned off.

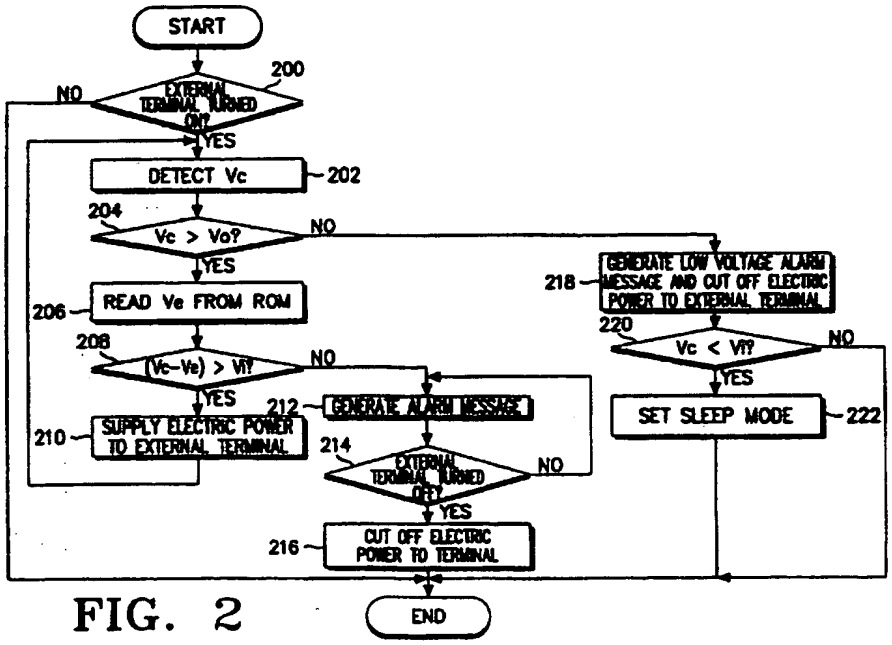

FIG. 2

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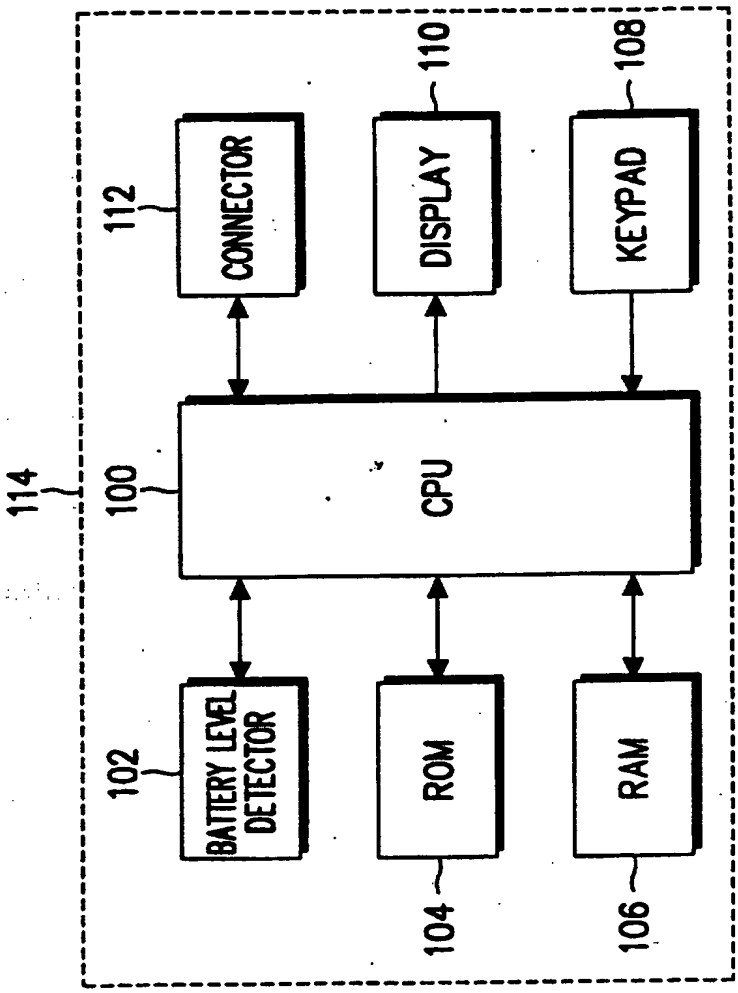
114
100
CPU
102
BATTERY LEVEL DETECTOR
104
ROM
106
RAM
112
CONNECTOR
110
DISPLAY
108
KEYPAD

FIG. 1

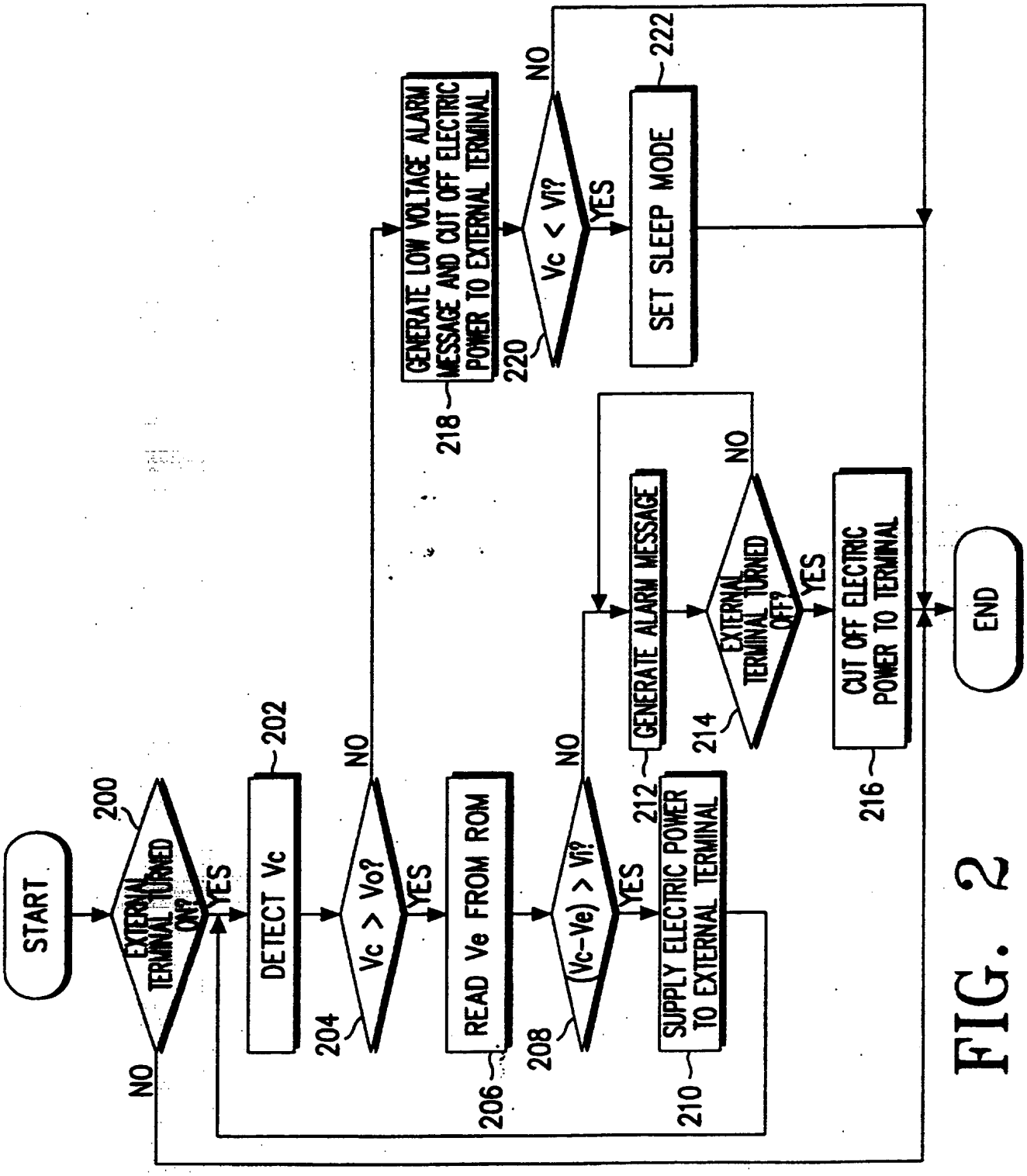
START
EXTERNAL TERMINAL TURNED ON?
200
YES
NO
DETECT Vc
202
Vc > Vo?
204
YES
NO
READ Ve FROM ROM
206
(Vc-Ve) > Vi?
208
YES
NO
SUPPLY ELECTRIC POWER TO EXTERNAL TERMINAL
210
GENERATE ALARM MESSAGE
212
EXTERNAL TERMINAL TURNED OFF?
214
YES
NO
CUT OFF ELECTRIC POWER TO TERMINAL
216
GENERATE LOW VOLTAGE ALARM MESSAGE AND CUT OFF ELECTRIC POWER TO EXTERNAL TERMINAL
218
Vc < Vi?
220
YES
NO
SET SLEEP MODE
222
END

FIG. 2

POWER MANAGEMENT METHOD FOR A PERSONAL DIGITAL ASSISTANT

The present invention relates to a personal digital assistant, and in particular, to a power management method of a personal digital assistant to which an external communication terminal is connectable.

A personal digital assistant (hereinafter referred to as PDA) is a multimedia device which allows access to desired information in a desired form at anytime and anywhere, and it has various utilities according to the needs of users. For instance, the PDA has a personal information management (PIM) function for managing an address book, a telephone dictionary, a personal schedule and memorandum, and an additional function for gathering and exchanging information by way of a facsimile or personal computer (PC) communication. Furthermore, the PDA may have an external communication terminal such as a portable radio telephone connectable thereto. If necessary, those two devices may be unified into one body.

In this case, the PDA may be overloaded due to lack of the power supply voltage. Therefore, there has been a demand for a PDA capable of preventing the overload, even in case where the external communication terminal is connected thereto.

It is therefore an aim of at least preferred embodiments of the present invention to provide a power management method for preventing overload of a personal digital assistant to which an external communication terminal is connectable.

According to a first aspect of the present invention, there is provided a power management method for a PDA

(personal digital assistant) to which an external communication terminal is connectable. Upon detecting power-on of the external communication terminal, the PDA detects a battery voltage thereof and compares the battery voltage with a reference voltage slightly higher than an inoperable voltage of the PDA. As the result, if the battery voltage is lower than the reference voltage, the PDA generates a low-voltage alarm message and otherwise, if the battery voltage is higher than the reference voltage, the PDA supplies an electric power to the external communication terminal.

According to a second aspect of the present invention there is provided a power management method for a personal digital assistant having an external communication terminal connectable thereto, said method comprising steps of: detecting a battery voltage of said personal digital assistant; comparing said battery voltage to a predetermined reference voltage; supplying electric power to an external communication terminal, if said battery voltage is higher than said reference voltage.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic block diagram of a personal digital assistant (PDA) to which an external communication terminal is connectable;

Figure 2 is a flowchart for managing power of the PDA shown in Figure 1 according to a preferred embodiment of the present invention.

A preferred embodiment of the present invention will be described in detail hereinbelow with reference to the accompanying drawings. For comprehensive understanding of the present invention, the present invention will be illustratively described, confined to the specific embodiment. However, it should be noted that the present invention can be implemented by anyone skilled in the art with the description, not the details. In the following description, well-known functions or constructions which may obscure the present invention in unnecessary detail are not described in detail.

Referring to Figure 1, a PDA 114 to which the present invention is applicable includes a central processing unit (CPU) 100 for controlling an overall operation of the PDA 114 according to a control program stored in a ROM (Read Only Memory) 104. The ROM 104 stores the control program of the CPU 100, data representative of a voltage drop according to power consumption of an external communication terminal connected to the PDA 114, and various reference data (e.g., data indicative of an inoperable voltage Vi of the PDA). A RAM (Random Access Memory) 106 temporarily stores data generated in the process of executing the control program by the CPU 100. A keypad 108 includes a plurality of numeric and function keys for generating key data to the CPU according to a key depression by the user. A display 108 displays thereon various operational status of the PDA 114 under the control of the CPU 100. A connector 112 consists of a serial port to connect the PDA 114 to the external communication terminal, and interface various data and control signals with the external communication terminal under the control of the CPU 100. A battery level detector 102 detects a voltage level of a battery (not shown) of the PDA 114 under the control of the CPU 100.

Figure 2 shows a flowchart for managing the power of the PDA 114, in which the CPU 100 detects a voltage difference between a battery voltage Vc and a voltage drop Ve according to the power consumption of the external communication terminal, to cut off an electric power from the external communication terminal if the voltage difference is lower than the inoperable voltage Vi of the PDA 114. The control flow of Figure 2 is programmed into the ROM 104 and executed by the CPU 100.

Now, referring to Figures 1 and 2, if the user turns on the external communication terminal connected to the PDA 114 at step 200, the CPU 100 of the PDA 114 proceeds to step 202 to detect the battery voltage Vc by virtue of the battery level detector 102. The CPU 100 checks, at step 204, whether the battery voltage Vc is higher than a first reference voltage Vo indicative of an alarm generation voltage. The alarm generation voltage Vo is a voltage slightly higher than a threshold voltage at which the PDA 114 can not operate normally. The alarm generation voltage Vo can be properly set according to various operating condition of the PDA 114. If the battery voltage Vc is lower than the alarm generation voltage Vo, the CPU 100 proceeds to step 218 to generate a low-voltage alarm message through the display 110 or a speaker (not shown) and cut off electric power to the external communication terminal. Thereafter, the CPU 100 checks, at step 220, whether the battery voltage Vc is lower than the inoperable voltage Vi at which the PDA 114 can not operate normally. If the battery voltage Vc of the PDA 114 is higher than the inoperable voltage Vi, the CPU 100 performs the END step. However, if the battery voltage Vc of the PDA 114 is lower than the inoperable voltage Vi, the CPU 100 sets the PDA 114 to a sleep mode. In the sleep mode, every part of the PDA 114 is inactive other than a

particular function of the CPU 100 such as a power-on/off function.

However, if the battery voltage Vc is higher than the alarm generation voltage Vo at the step 204, the CPU 100 proceeds to step 206 to read, from the ROM 104, a voltage drop Ve according to the power consumption of the external communication terminal. The ROM 104 previously stores data corresponding to the voltage drop Ve of the respective external communication terminals to be connected to the PDA 114. The CPU 100 checks, at step 208, whether a voltage difference (Vc-Ve) between the battery voltage Vc and the voltage drop Ve is higher than the inoperable voltage Vi. If the voltage difference is lower than the inoperable voltage Vi, the CPU 100 proceeds to step 212 to generate an alarm message informing that it is impossible to power on the external communication terminal connected to the PDA 114. The CPU 100 checks, at step 214, whether the external communication terminal is powered off. If it is not powered off, the CPU 100 returns to step 212 to repeat the steps 212 and 214 until the user powers off the external communication terminal. In the meantime, if the external communication terminal is powered off at the step 214, the CPU 100 cuts off the electric power to the external communication terminal at step 216. However, if the voltage difference (Vc-Ve) is higher than the inoperable voltage Vi, the CPU 100 proceeds to step 210 to supply the electric power to the external communication terminal and then, returns to the step 202 to repeat the steps 202 through 210. In this way, the PDA can prevent the overload of the battery.

Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the

invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope of the invention.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A power management method for a personal digital assistant to which an external communication terminal is connectable, comprising the steps of:

upon detecting power-on of said external communication terminal, detecting a battery voltage of said personal digital assistant;

comparing said battery voltage with a reference voltage slightly higher than an inoperable voltage of said personal digital assistant;

generating a low-voltage alarm message, if said battery voltage is lower than said reference voltage; and

supply an electric power to said external communication terminal, if said battery voltage is higher than said reference voltage.

2. The method as claimed in claim 1, further comprising the step of setting the personal digital assistant to a sleep mode, if said battery voltage is lower than said inoperable voltage of said personal digital assistant.

3. The method as claimed in claim 1 or 2, further comprising the steps of:

calculating a difference voltage between said battery voltage and a voltage drop according to a power consumption of said external communication terminal;

comparing said difference voltage with said inoperable voltage at which said personal digital assistant can not operate normally;

if said difference voltage is lower than said inoperable voltage, repeatedly generating an alarm message informing that the battery voltage is insufficient to normally activate said external communication terminal, until said external communication terminal is turned off; and

providing the electric power to said external communication terminal, if said difference voltage is higher than said inoperable voltage.

4. The method as claimed in claims 1, 2 or 3, wherein said alarm messages are generated through a display or a speaker.

5. A power management method for a personal digital assistant having an external communication terminal connectable thereto, said method comprising steps of:

detecting a battery voltage of said personal digital assistant;

comparing said battery voltage to a predetermined reference voltage;

supplying electric power to an external communication terminal, if said battery voltage is higher than said reference voltage.

6. A method according to claim 5, further comprising any one or more of the features disclosed in the accompanying specification, claims, abstract and/or drawings, in any combination.

7. A method substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

The Patent Office

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Claims searched: 1-7

Examiner: K. Sylvan
Date of search: 25 November 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G4A (AFML,AEP) H4L (LECTX,LECX)

Int Cl (Ed.6): G06F (1/28,1/30) H04M (1/72) H04Q (7/32) H02H (11/00)

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2302770 A	Motorola. See abstract.	-
A,P	WO 98/10610 A1	Ericsson. See abstract.	-
A	US4984185	Toshiba. See abstract and column 1 lines 30-45	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.